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tle of the invention MILKING EQUIPMENT AND METHOD

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I/We request the grant of a patent on the basis of this application.

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MILKING EQUIPMENT AND METHOD

The present invention relates to milking equipment and, more particularly, to devices and methods for enabling the application of treatment fluid to animals' teats and the cleansing of teat cups, post milking.

Conventionally, automatic milking equipment installed in a milking parlor comprises a milking point at each animal stall within the parlor. Each milking point includes a milking cluster of teat cups for connecting the equipment to the teats of an animal to be milked. In the case of cows, for example, each milking cluster has four teat cups. Each teat cup comprises a hollow shell supporting a flexible liner which has a barrel portion for engaging about a teat and, at its upper end, a head portion with an opening through which the teat is engaged with the barrel of the liner. At the opposite, discharge end of the teat cup, the liner communicates with a flexible, short milk tube connected to a, so called, clawpiece of the cluster where the milk extracted from the animals teats is collected and delivered, via a flexible, long milk tube, to the collection chamber of the equipment. Upon commencement of milking, a vacuum is applied to the liner, via the long milk tube, the clawpiece and the short milk tubes, for the purposes of extracting milk from the teat cups and, upon initial application, this vacuum is applied to a void in the head of each liner and between the liner and the teat, which captures the cup on the teat. Milking is achieved by automatically and alternately applying vacuum and atmospheric pressure pulses to the space between the shell and the liner of each teat cup in order to flex the liner and stimulate discharge of milk from the engaged teat. The clawpiece includes a distributor for distributing the pneumatic pulses to the individual teats, via flexible pneumatic lines, as well as for distributing disinfectant and other treatment fluid, water and compressed air to the individual teat cups for the purposes of treating and cleansing the teats and teat cups.

After completion of the milking cycle, the milking cluster at each milking point is withdrawn from the teats (commonly referred to as "take-off") by an automatic cluster remover and the animal's teats are manually or automatically treated with disinfectant and conditioning fluid, such as, iodine or chlorohexadine

and an emollient. For example, the teats may be treated with treatment fluid injected within the head of the liner of each teat cup, as described in my copending application No 0324647.7. That application describes a teat cup for milking equipment in which the cup has nozzle means for injecting treatment fluid into the head of the liner of the teat cup and on to a teat engaged by the cup. By injecting fluid at this position prior to take-off, the teat is coated immediately after milking giving protection before the teat is exposed to the environment. Moreover, any vaporized liquid is contained within the head of the liner thereby reducing the omission of vapour and spray mist associated with both current and manual automatic spray devices with consequent reduction of the health risk.

With the teat cup described in my prior application, the injection of the treatment fluid may be initiated in response to a signal initiating automatic cluster removal, whereupon fluid is injected into the heads of the liners and the voids about the animal's teats. The fluid is applied to the teats and is also wiped down the latter as the teat cups are removed. Thereafter, the teat cups are flushed or rinsed internally and dried, for example, with disinfectant, water and compressed air. Hitherto, this has typically been done by back flushing, or internally rinsing the teat cups, via flush valves connecting the short milk tubes to the discharge ends of the teat cups. Upon take off, the milking cluster is designed so as to enable the short milk tubes to fall away from the centre line of the cluster so that the teat cups are inverted and hang with their heads downwardly from the claw device, and back flushing is performed with the teat cups in this position. Consequently, liquid can escape from the heads of the teat cups.

During treatment of the teats and cleansing of the teat cups, there is a risk that the fluids used may contaminate the harvested milk if they are not physically prevented from entering the short milk tubes. Accordingly, a shut-off

subsequent to milking, treatment and cleansing fluids are injected into the teat cups.

It is an object of the present invention to simplify the processes of treating an animal's teat and the teat cup and cleansing the teat cup, post-milking. Another object is to simplify the construction of the teat cup and associated components for conducting the treatment and cleansing process

To this end, the invention consists in a teat cup for milking equipment, in which the cup has nozzle means for injecting fluid into the head of the liner of the teat cup and onto a teat engaged with the cup, and in which the nozzle means is arranged so as to discharge fluid in a direction towards the barrel of the liner and is selectively connectable to supplies of treatment and cleansing fluid.

In addition to enabling treatment fluid to be injected into the head of the cup liner so as to coat the engaged teat prior to take off, the teat cup of the invention serves the dual purpose of enabling disinfectant, washing and drying fluids to be injected upwardly into the barrel of the liner when the teat cup falls into its inverted position, with its head downwardly, upon take off, so as to permit cleansing of the teat cup liner.

Preferably, the teat cup according to the invention is used with a shut-off valve which is connected to the discharge end of the liner and which can be actuated to prevent ingress of treatment and cleansing fluids through the short milk tube and thereby contamination of the harvested milk. Conveniently, the shut-off valve is mounted on the teat cup at the discharge end of the liner.

In the event that a teat cup becomes entangled and is held with its liner in a head up attitude, a non-return bleed valve may be disposed upstream of the shut off valve in order to allow liquid to drain from liner.

A pressure actuated non-return valve for controlling admission of treatment fluid to the injection nozzle may be disposed in the treatment fluid delivery line adjacent the clawpiece so that treatment fluid is retained in the delivery line. The delivery line is thus primed with treatment fluid which can be supplied in a timely manner to the teat cups at low pressure and without the

addition of high volumes of compressed back-up air which has hitherto been used to ensure timely application of treatment fluid to teat cups.

The present invention also consists in a method of milking which includes the steps of detecting when the milking cycle of a teat cup is to be terminated, dispensing treatment fluid into the head of the liner of the teat cup and onto the engaged teat in response to said detecting step, instigating take off of the teat cup so as to wipe the teat with the treatment fluid, allowing the teat cup to fall into an inverted position after take off, with its head downwardly, and flushing the liner with cleansing fluid injected upwardly into the barrel of the liner from the liner head.

Preferably, the discharge end of the teat cup liner is shut off in response to the detecting steps so as to prohibit the treatment and cleansing fluid from flowing through the short milk tube and contaminating the harvested milk.

In order that the present invention may be more readily understood, reference will now be made to the accompanying drawings, in which:-

Figure 1 is an axial section through a teat cup and associated shut off valve, when in the milking position, with the valve being shown in an unactuated condition,

Figure 2 is a view similar to Figure 1 showing the valve in an actuated condition, and

Figure 3 is a view similar to Figure 2 showing the valve and teat cup in the inverted position which the teat cup is designed to adopt after take off,

The teat cup illustrated in Figures 1, 2 and 3 of the accompanying drawings is one of four similar teat cups of a milking cluster used for milking a cow and which is connected to automatic milking equipment. Each teat cup 1 comprises a hollow cylindrical shell 2 supporting a flexible liner 3 in spaced relation with the shell. The liner has a barrel portion 3 sealed to the shell

of the liner. Between the top of the barrel 8 of the liner and the opening 7, the head of the liner is formed with an internal annular cavity 9 which, when an animal's teat is inserted into the cup through the opening 7, forms a void or space 10 between the side of the teat and the head. At the discharge end 4 of the cup, the liner communicates with a flexible, short milk tube 11 connecting the teat cup to a clawpiece (not shown) of the milking cluster and, via which, vacuum is applied to the inside of the liner for removing from the cup, milk discharged by the teat during the milking cycle. By way of example, the shell 2 may be produced from stainless steel or plastics material and the liner 3 may be moulded from resilient plastics, synthetic rubber or silicone.

As will be appreciated by those skilled in the art, the cup 1 is fitted with suitable means (not shown) for connecting the space 12 between the shell 2 and the liner 3, via the clawpiece, to the associated milking point which has control means for alternately supplying vacuum pulses and venting the space 12 to atmosphere in order to cause the liner 3 to flex against the teat and stimulate a milking operation. The vacuum is supplied from a common source connected to the milking point by the manifold assembly of the milking equipment.

Extending into the head 6 of the liner, and into the cavity 9 on the inside of the liner, is an injection nozzle 13 which is integral with a tube 14 for delivering fluid to the nozzle. This tube extends down the outside of the teat cup shell 2 where it is enclosed in a housing 15 attaching it to the outside of the teat cup and has its distal end coupled, via the housing of a shut-off valve 20 (more fully described below), to a control valve system for selectively connecting the nozzle to supplies of disinfectant, conditioner, washing water and compressed air. The injection nozzle 13 is designed so as to direct fluid discharged from the nozzle inwardly and downwardly into the interior of the barrel 8 of the liner, as viewed in Figures 1 and 2.

When the teat cups have been fitted to a cow's udder and the milking equipment is being operated in a milking cycle, vacuum is applied to each short milk tube 11 in order to extract, from the associated teat cup, milk discharged into the liner from the engaged teat. This vacuum is also applied, via the liner, to

the void 10 between the engaged teat and the head 6 of the liner and serves to capture the cup on the teat. Vacuum and atmospheric pressure are then alternately applied in pulses to the space 12 between the liner and the shell in order to flex the liner against the teat and stimulate milking. Milk discharged by the teat into the barrel 8 of the liner is extracted from the liner, via its discharge end 4, for delivery to a collecting vessel of the milking equipment. During this milking cycle, clean filtered air at atmospheric pressure is admitted into the head of the liner, via the delivery tube 14 and the injection nozzle 13, under the control of a vacuum control valve, in order to avoid the occurrence of excessive vacuum in the liner head and the risk of the liner creeping up the teat with resultant discomfort to the animal.

The discharge end 4 of each teat cup liner is coupled to the associated short milk tube 11 by a shut off valve 20. The latter comprises a valve body 21 having a milk passageway 22 therethrough, opposite ends of which terminate in spigots 23,24 connecting the milk passageway to the discharge end 4 of the teat cup liner and the short milk tube, respectively. The valve body 21 has a cylindrical valve chamber 25 to one side of the milk passageway 22 which is connected to the latter via a circular opening 26. A valve member 27 moulded from flexible membrane material, such as, rubber, silicone or other elastomeric material, forms a seal between the chamber 25 and the opening 26. The membrane valve member 27 is moulded in a cylindrical cap-like shape having its cap portion 27a projecting into the chamber 25 and the cavity in the cap portion facing the milk passageway 22, when in the unactuated position shown in Figure 1. This valve member is retained in position by an outwardly projecting radial flange 28 about the mouth of its cavity trapped between mating parts of the valve body. The valve chamber 25 is selectively connectable to a source of pneumatic pressure or vacuum for controlling the valve member 27 via a port 29

27. A recess 31 is formed about the internal wall of the milk passageway 22 adjacent the valve chamber 25 for locating the valve member 27 when the latter is extended across the passageway in its actuated position.

The valve body 21 of the shut-off valve serves as a fixing point for the distal end of the delivery tube 14 for the injection nozzle 13. At its distal end, the delivery tube is coupled to a treatment fluid passageway 32 formed through the valve body and having its inlet end 33 connected to a treatment fluid supply tube 34 connected to the valve control system for selectively connecting the nozzle to supplies of treatment and cleansing fluid. The inlet end 33 of the passageway 32 includes a pressure operated non-return valve 25.

Formed through the wall of the valve body 21 immediately upstream of the location recess 31 is a drain port 37 for enabling fluid trapped by the shut-off valve to drain from the valve. This port is controlled by a non-return flap valve 38 mounted on the valve body at the external end of the drain port 37.

Sanitising, rinsing and drying fluids, such as disinfecting and conditioning liquid, water and compressed air, as well as compressed air and vacuum for providing pneumatic control signals, are supplied to each milking point, from common sources, by a manifold system. At each milking point, a stall control unit incorporating solenoid operated valves selectively supplies the fluids from the manifold system to the teat cups 1, via a distributor mounted on the clawpiece and flexible tubing connecting the distributor to the teat cups. The clawpiece also serves to distribute pneumatic milking pulses derived from suitable sources to the spaces 12 in the teat cups for milking purposes. The apparatus for generating and supplying the pneumatic milking pulses is conventional and, since it forms no part of the present invention, it will not be described in detail.

When the teat cups are attached to the teats of a cow for milking, the teat cups are in the position generally illustrated in Figures 1 and 2 with their heads 6 uppermost. Milking is stimulated conventionally by applying pneumatic pulses to the space 12 between the shell 2 and the liner 3 of each teat cup, via the claw device, the pulses being alternately applied to pairs of the teat cups. During the

milking cycle, the shut-off valves 20, are in the open position, as illustrated in Figure 1. Milk is extracted from each teat cup, via the associated shut off valve and the short milk tube 11, by vacuum applied through the claw device. This vacuum retains the non-return flap valves 38 in the closed condition so that milk cannot bleed through the drain port 37.

When the milking cycle is to be terminated, which is detected by a milk flow meter of the stall control unit as a reduction of milk flow below a predetermined level, the automatic cluster remover is signaled to take off the cluster from the cow's udder and, also, the programmable electronic circuit board of the stall control unit is signaled to commence the treatment and cleansing cycle. The valve system of the milking equipment maintains the supply line to the stall control unit primed with disinfectant so that, when the system is actuated to supply disinfectant to the tubes 34, disinfectant is supplied and distributed to the injection nozzles 13 in the liner heads of the teat cups with minimum delay and can be delivered at low pressure. The injection of this fluid is timed to occur upon or immediately prior to actuation of the cluster remover. Removal of the cluster from the teats may be aided by delivering pulses and/or a charge of low pressure compressed air to the injection nozzles 13 and into the void 10 in each cup, as the cups are being removed. In any event, as the cups are removed, the disinfectant is sprayed, spread and wiped down the outside of each teat, thus ensuring that the whole teat is hygienically coated with disinfecting liquid. Because the fluid is injected at low pressure and because it is contained within the voids 10 as the cups are removed from the teats, this alleviates the problem of fluid vapor or mist in the surrounding environment and consequent health risks. Prior to full take off, compressed air is applied to the shut-off valves 20 via the pneumatic tubes 30, to actuate or extend the membrane valve members 27. As illustrated in Figure 2, upon the application of

a pressure sensor monitors the shut-off valves to sense whether or not the valve members have operated correctly. If it has not, the associated milking cluster will be shut down in conjunction with the actuation of an alarm.

Following actuation of the shut off valves 20 and take off, the teat cups 1 naturally fall into a position in which they hang downwardly from the short milk tubes 11 and in an inverted position with their heads downwardly, as illustrated in Figure 3. When the teat cups fall into this downwardly hanging position, the control valve system connected to the supply tubes 34 is actuated so as, for example, sequentially to deliver two pulses of water, a pulse of disinfectant, such as iodine, two further pulses of water and then compressed air to the nozzles 13. Nozzles 13 spray these various fluids upwardly into the barrels 8 of the teat cup liners. The first two pulses of water flush the liners to wash away milk residue, soil and traces of the original disinfectant. The subsequent pulse of disinfectant is used to disinfect the liners and thereafter the pulses of water and compressed air wash away the disinfectant and dry the liners preparatory to the next milking cycle. Subsequent to the air drying pulses, vacuum is applied to the pneumatic lines 30 of the teat cups in order to retract the membrane valve members 27 from the milk passageways 22 into the valve chambers 23 and restore the valve members to the position shown in Figure 1.

Because vacuum is no longer applied to the milk passageways 22 to withdraw milk from the teat cups when the milking cycle is terminated, the pressure in the milk passageways above the extended membrane valve members 27 returns to atmospheric pressure and the flap valves 38 are free to open. This provides the facility for any fluid to drain away if a teat cup, for some reason, becomes entangled and is prevented from falling over upon take off and is held in a partially upright position.

Whilst a particular embodiment has been described, it will be understood that modifications can be made without departing from the scope of the invention.

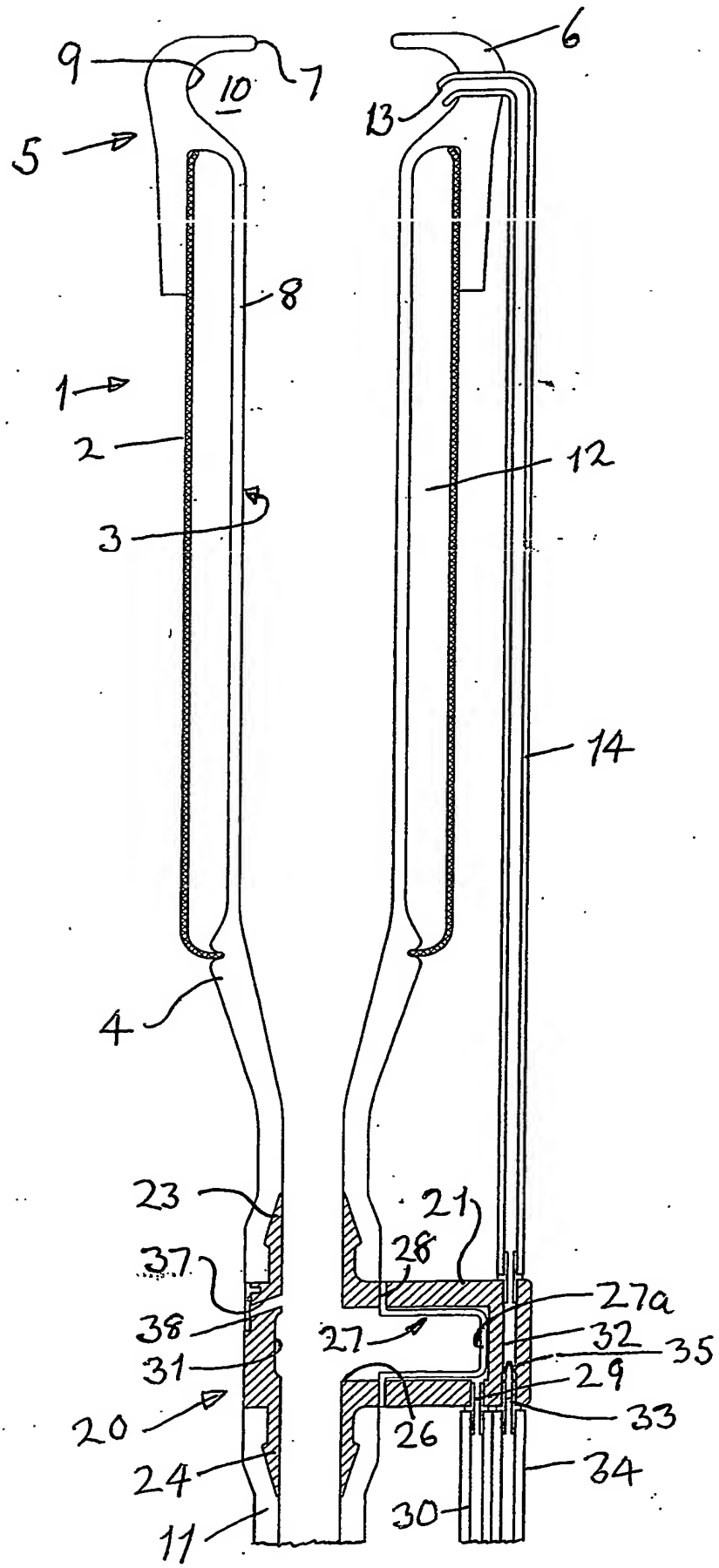
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Fig 1

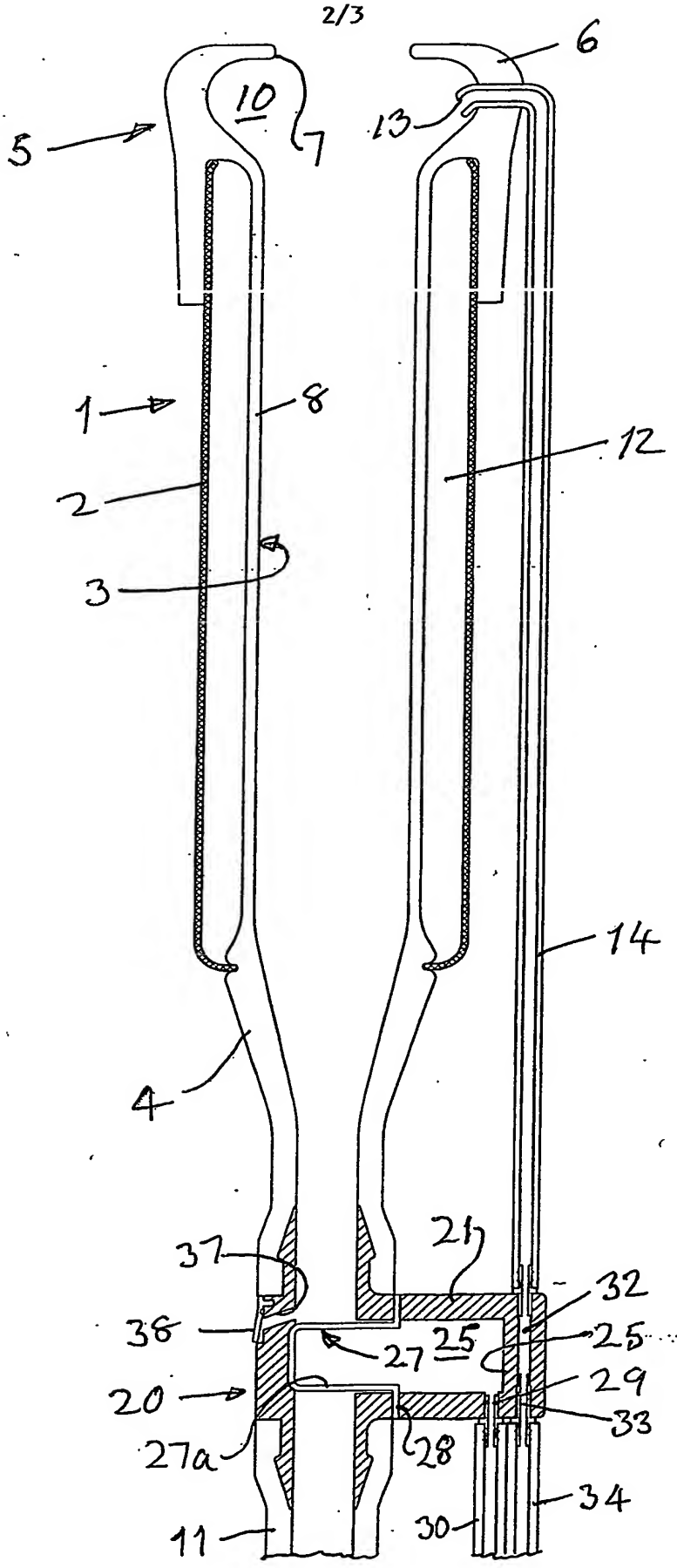

Fig 2

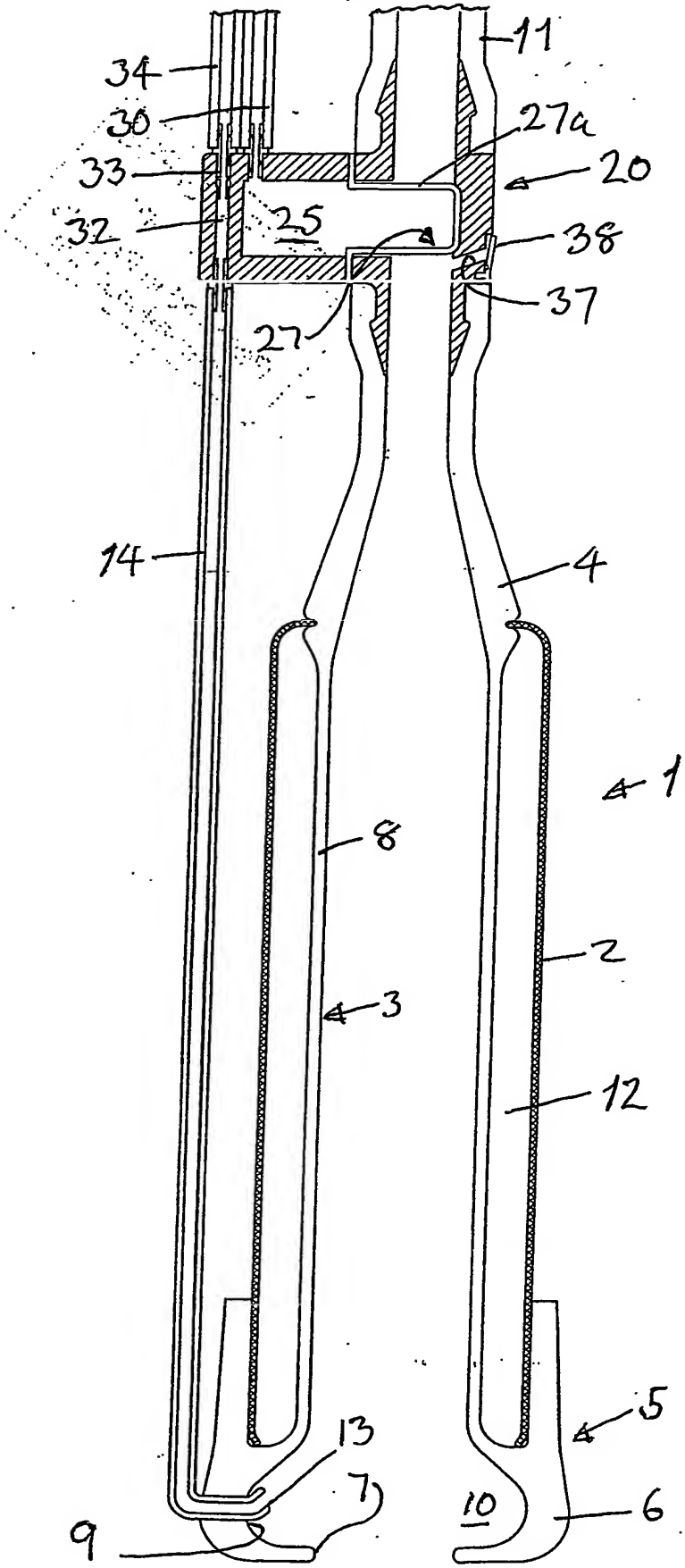

Fig 3